

1 **CLAIMS**

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3 1. A rotor for a wind turbine comprising a plurality
4 of radial blades and a ring-shaped aerofoil diffuser
5 connecting the outer tips of the blades.

6

7 2. A rotor according to claim 1, wherein the
8 aerofoil diffuser extends downstream from the outer
9 tips of the blades.

10

11 3. A rotor according to either preceding claim,
12 wherein the outer tips of the blades are connected
13 to the diffuser at or near to the leading edge of
14 the diffuser.

15

16 4. A rotor according to any preceding claim, wherein
17 the aerofoil diffuser tapers outwards from the outer
18 tips of the blades to form a substantially frusto-
19 conical diffuser.

20

21 the rotational axis of the frusto-conical diffuser
22 is substantially aligned to the rotational axis of
23 the blades.

24

25 5. A rotor according to claim 1, wherein at least a
26 portion of the aerofoil diffuser extends upstream
27 from the outer tips of the blades.

28

29 6. A rotor according to any preceding claim, wherein
30 the aerofoil diffuser tapers radially outwards as it
31 extends from the upstream end to the downstream end.

32

1 7. A rotor according to any preceding claim, wherein
2 the aerofoil diffuser is shaped such that it
3 inhibits the partly axial and partly radial airflow
4 from the blades, said airflow becoming
5 circumferential when it contacts the aerofoil
6 diffuser.

7
8 8. A rotor according to any preceding claim, wherein
9 the aerofoil diffuser is adapted to inhibit partly
10 axial and partly radial airflow from the outer tips
11 of the blades and divert said airflow to
12 substantially circumferential airflow during normal
13 operation.

14
15 9. A rotor according to any preceding claim, wherein
16 the blades are inclined at an angle relative to a
17 transverse rotor plane perpendicular to the
18 rotational axis of the rotor.

19
20 10. A rotor according to claim 9, wherein the angle
21 of inclination may vary along the length of the
22 blade.

23
24 11. A rotor according to claim 9 or claim 10,
25 wherein the angle of inclination of each blade is
26 greater at an intermediate portion of the blade than
27 at the outer tip of the blade.

28
29 12. A rotor according to any preceding claim,
30 wherein the blades are substantially parallel to the
31 transverse rotor plane at the outer tip of the
32 blades.

1

2 13. A wind turbine comprising a rotor according to
3 claims 1 to 12, further comprising a nacelle and a
4 mounting means adapted to allow rotation of the
5 turbine and rotor about a directional axis
6 perpendicular to the rotational axis, thus allowing
7 the turbine to be oriented in the optimum direction
8 depending on wind conditions.

9

10 14. A wind turbine according to claim 13, further
11 comprising a furling means adapted to rotate the
12 rotor about the directional axis so that the
13 rotational axis is not parallel to the direction of
14 airflow when the airflow speed is greater than a
15 predetermined airflow speed.

16

17 15. A wind turbine according to claim 14, wherein
18 the furling means comprises a non-linear furling
19 means adapted to provide no furling over a first
20 lower range of airflow speed and a varying degree of
21 furling over a second higher range of airflow speed.

22

23 16. A wind turbine according to claims 14 and 15,
24 wherein the furling means comprises at least two
25 tail fins extending downstream of the diffuser.

26

27 17. A wind turbine according to claim 16, wherein
28 the two tail fins are provided diametrically
29 opposite each other.

30

31 18. A wind turbine according to claim 16 or 17,
32 wherein one of the tail fins is a moveable tail fin

1 hingedly mounted for rotation about a tangential
2 hinge line.

3

4 19. A wind turbine according to claim 18, wherein
5 the moveable tail fin may be mounted on a mounting
6 boom and the hinge line may be provided: at the
7 connection point of the mounting boom and the
8 nacelle, so that the mounting boom also rotates; at
9 the connection between the mounting boom and the
10 moveable tail fin so that only the moveable tail fin
11 rotates; or at any point along the length of the
12 mounting boom.

13

14 20. A wind turbine according to claims 18 or 19,
15 wherein the tail fin rotates about a horizontal axis
16 under high winds resulting in a fin which folds
17 about a horizontal axis.

18

19 21. A wind turbine according to claims 18 to 20,
20 wherein the moveable tail fin is rotationally biased
21 by biasing means to an at-rest position in which the
22 leading edge of the moveable tail fin is closer to
23 the axis of rotation of the rotor than the trailing
24 edge of the moveable tail fin, such that the
25 moveable tail fin is angled at an at-rest attack
26 angle to the axis of rotation of the rotor.

27

28 22. A wind turbine according to claim 21, wherein
29 the biasing means is non-linear.

30

31 23. A wind turbine according to claim 21 or 22,
32 wherein the biasing means is adapted to hold the

1 moveable tail fin in the at-rest position until the
2 airflow speed reaches a predetermined speed and is
3 further adapted such that as the airflow speed
4 increases beyond the predetermined speed the
5 moveable fin rotates and the attack angle decreases,
6 resulting in unbalanced aerodynamic loading on the
7 wind turbine, such that the wind turbine rotates
8 about its mounting axis to a furled position.

9
10 24. A wind turbine system comprising:
11 a wind turbine driven generator and means for
12 providing a power output.

13
14 25. A wind turbine system according to claim 24,
15 wherein the system further comprises an electronic
16 control system.

17
18 26. A wind turbine system according to claim 24 or
19 25, wherein the system comprises a dump element
20 comprising one or more energy dissipaters.

21
22 27. A wind turbine system according to claim 26,
23 wherein the energy dissipaters are in the form of
24 resistive elements.

25
26 28. A wind turbine system according to claims 26 or
27 27, wherein the dump element is in the form of a
28 liquid storage vessel having electrical heating
29 elements therein adapted to heat liquid in said
30 storage vessel.

31

1 29. A wind turbine system according to claim 28,
2 wherein the control system may be adapted to supply
3 electrical power to said one or more electrical
4 heating elements when the power from the wind
5 exceeds a predetermined power.

6

7 30. A wind turbine system according to claim 28 or
8 29, wherein the liquid storage vessel is a cold
9 water tank and the liquid is water.

10

11 31. A wind turbine system according to claim 28 or
12 29, wherein the heating element is a radiator.

13

14 32. A wind turbine system according to claim 26,
15 wherein the dump element is activated by the
16 electronic control system when the power available
17 from the wind exceeds the power take-off due to a
18 loss or reduction of electrical load caused by the
19 switching off, reduction or separation of the said
20 electrical load.

21

22 33. A wind turbine system according to claim 32,
23 wherein the dump element is activated when the rotor
24 speed increases above a defined "dump on" rotor
25 speed caused by the imbalance of wind turbine rotor
26 torque and wind turbine generator torque, said wind
27 turbine rotor torque being dependent on wind speed
28 and the said wind turbine generator torque being
29 dependent on the electrical load.

30

31 34. A wind turbine system according to claim 33,
32 wherein said dump element is adapted to increase the

1 wind turbine generator torque above the wind turbine
2 rotor torque reducing the wind turbine rotor speed
3 until it approaches or reaches a stall and is
4 further adapted such that the generator torque is
5 released when the wind turbine rotor speed falls
6 below a defined "dump off" rotor speed, the said
7 "dump on" and "dump off" rotor speeds being defined
8 proportionally to the power take-off.

9
10 35. A wind turbine system according to claims 24 to
11 34, wherein the wind turbine system is provided with
12 a control means adapted to control the level of
13 power taken from the wind turbine.

14
15 36. A wind turbine system according to claim 35,
16 wherein the control system is adapted to increase or
17 decrease the power take-off from the wind turbine by
18 a small amount relative to the total power take-off.

19
20 37. A wind turbine system according to claims 24 to
21 36, wherein the system comprises a wind turbine
22 according to claims 1 to 23.

23
24 38. A wind turbine system according to claims 24 to
25 37, wherein the power output is connected to a
26 heating system further comprising a further liquid
27 storage vessel,
28 one or more electrical heating elements adapted
29 to heat liquid in said further vessel, and
30 control means adapted to control the supply of
31 electricity generated by said generator to said one
32 or more electrical heating elements.

1

2 38. A wind turbine system according to claim 37,
3 wherein the further liquid storage vessel is a hot
4 water tank and the liquid is water.

5

6 39. A wind turbine system according to claim 38,
7 wherein the heating system comprises a plurality of
8 electrical heating elements, and the control means
9 is adapted to supply electrical power to a
10 proportion of the electrical heating elements, the
11 proportion being dependent upon the instantaneous
12 electrical power generated by the generator.

13

14 40. A wind turbine system according to claim 39,
15 wherein the heating element in the further liquid
16 vessel is enclosed by means of a tube, open on the
17 underside thereof and adapted to allow water to flow
18 from beneath the tube towards the heating element.

19

20 41. A wind turbine system according to claim 40,
21 wherein the tube encloses and extends over the
22 entire length of the heating element such that the
23 water near the heating element is heated and will
24 flow upwards due to natural convection, the tube
25 being adapted to enable the formation of different
26 and separate heat zones within the further liquid
27 storage vessel.

28

29 42. A wind turbine system according to claims 24 to
30 41, wherein the power output is connected to a grid-
31 tie inverter or stand alone inverter.

32

1 43. A wind turbine system according to claim 42,
2 wherein the inverter is adapted to supply power to
3 local or grid power infrastructure.
4

5 44. A wind turbine system according to claims 24 to
6 43, wherein the power output is connected to an
7 energy storage system.
8

9 45. A method of controlling the level of power taken
10 from a wind turbine comprising the following steps
11 taken by a control means:

- 12 (a) increasing or decreasing the power take-off
13 from the wind turbine by a small amount;
14 (b) temporarily setting the level of power take
15 -off;
16 (c) after a predetermined time period, taking a
17 number of measurements of the rotor speed;
18 (d) calculating the first, second and third
19 order values, namely speed,
20 acceleration/deceleration and rate of change
21 of acceleration/deceleration respectively,
22 to the said increase or decrease in power
23 take-off;
24 (e) adjusting the power taken from the wind
25 turbine in response to the calculation.
26

27 46. A method according to claim 45, wherein the
28 control means uses the following logic to
29 determine the adjustment:

- 30 (a) IF: there is a positive second order rotor
31 speed response (acceleration) and an
32 increasing rate of said acceleration

- 1 (positive third order response) of the rotor
2 speed; THEN: the control means causes an
3 increase in the power take-off; OR
4 (b) IF: there is a positive second order rotor
5 speed response (acceleration) and decreasing
6 rate of said acceleration (negative third
7 order response) of the rotor speed; THEN:
8 the control means causes an increase or
9 alternatively no change in the power take-
10 off; OR
11 (c) IF: there is a negative second order rotor
12 speed response (deceleration) and increasing
13 rate of said deceleration (positive third
14 order response) of the rotor speed; THEN:
15 the control means causes a reduction in the
16 power take-off; OR
17 (d) IF: there is a negative second order rotor
18 speed response (deceleration) and decreasing
19 rate of said deceleration (negative third
20 order response) of the rotor speed; THEN:
21 the control means causes an increase or
22 alternatively no change in the power take-
23 off.

24
25 47. A method according to claim 45 or 46, wherein
26 the control means repeats any of the above steps to
27 continue adjusting the power take-off to ensure that
28 the power take-off is always maximised to the power
29 available to the wind turbine which is dependent on
30 the local wind speed at the rotor plane.

31

1 48. A wind turbine according to claims 13 to 23
2 comprising means for reducing the operating
3 vibrations caused by harmonic resonance within the
4 turbine, tower and mounting structure.
5

6 49. A wind turbine according to claim 48, wherein
7 the wind turbine is provided with a nacelle damping
8 system, adapted to at least partially isolate the
9 vibrations in the generator and turbine from the
10 tower.
11

12 50. A wind turbine according to claim 48 or 49,
13 wherein the wind turbine is provided with mounting
14 brackets for mounting the turbine on a surface, the
15 brackets having a sandwich construction of visco-
16 elastic materials and structural materials.
17

18 51. A wind turbine according to claims 48 to 50,
19 wherein the mounting means is tubular.
20

21 52. A wind turbine according to claim 50, wherein
22 the tower contains one or more cores of flexible
23 material, such as rubber, with sections with a
24 reduced diameter, which are not in contact with the
25 tower's inner radial surface, such that the reduced
26 diameter sections alternate with normal sized
27 sections, which are in contact with the tower's
28 inner surface thus serving to absorb vibrations in
29 the tower through the energy dissipated in the
30 flexible core before they reach the mounting
31 brackets.
32

1 53. A wind turbine according to claim 52, wherein
2 the rubber core is adapted to control the system's
3 resonant frequency out-with the turbine driving
4 frequency by absorption of a range of vibration
5 frequencies.
6

7 54. A wind turbine according to claim 53, wherein
8 the cross-sectional shape and length of each of the
9 reduced diameter sections is altered thus "tuning"
10 the system to remove a range of vibration
11 frequencies from the mounting structure.
12

13 55. A wind turbine according to claims 48 to 54,
14 wherein the sandwich mounting brackets compliment
15 the mounting means core design and suppress
16 vibrations that come from the nacelle.
17

18 56. A wind turbine according to claim 55, wherein
19 the nacelle supports the generator through bushes
20 designed to eliminate vibration frequencies.